RTCA Special Committee 214 – Standards for Air Traffic Data Communication Services

An Overview for E-Operations Workshop

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Introduction

- Discussion focusing on what can we do with current equipment
- If we can enhance the equipment, how can we do better?

What is RTCA SC-214 doing?

- In plain terms:
  - Update of CPDLC (and ADS-C) specifications with new assumptions
    - Interoperability of ATN, FANS, and ACARS
    - Primary means of communication – voice supplemental
    - Goal of worldwide applicability
    - Consider requirements of NexGen, SESAR, etc.
  - These changes in scope ripple through the definitions of services and data links.
  - Backwards compatibility is expected for portions of CPDLC that have been implemented.
- These standards will drive the next generation of airborne capability.

What SC-214 is NOT

- ADS-B covered by SC-186/WG-51
- AIS/MET services covered by SC-206/WG-76
- Data Link Security covered by SC-216/WG-72

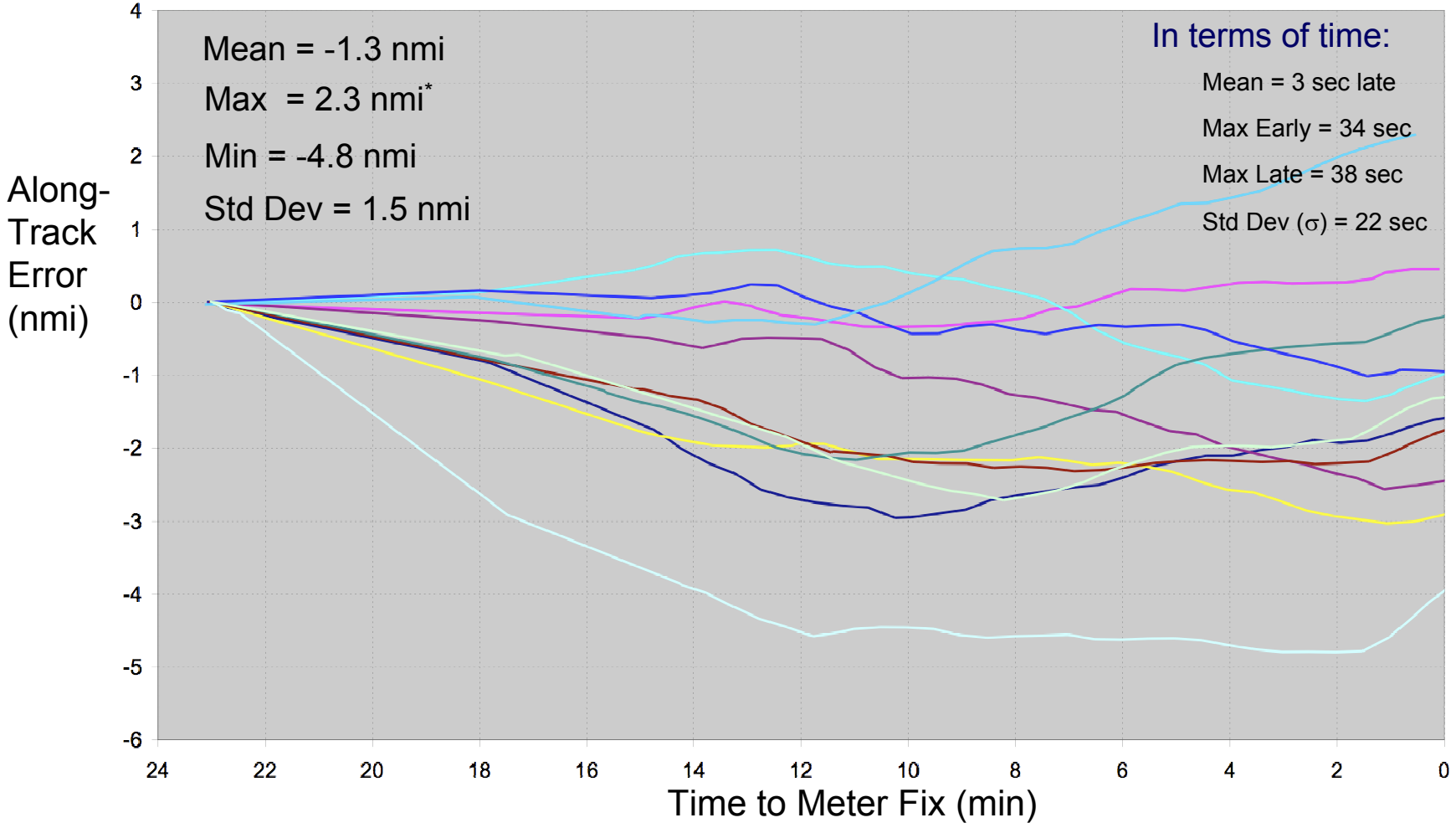
Motivation

- Why can't CDAs be used in high traffic density?
  - Lack of predictability in aircraft compression
  - Lack of predictability in terminal area
  - Communication / coordination between airspace
- **NextGen concepts use transmission of complex trajectory clearances, weather information and air traffic advisories.**
- **Data communications will:**
  - **Provide for a more efficient air/ground (A/G) information exchange mechanism**
  - **Provide an additional means of communication between pilots and controllers**
  - **Reduce congestion on the voice channels**
  - **Reduce operational errors and pilot deviations resulting from misunderstood instructions and read back errors**
  - **Enable trajectory based operations**
  - **Reduce controller and flight crew workload.**

Example from Tailored Arrivals results

Enroute Descent Advisor – Along Track Prediction Accuracy - 23 min time horizon

Acknowledgement: from Rich Coppenbarger, NASA Ames Research Center



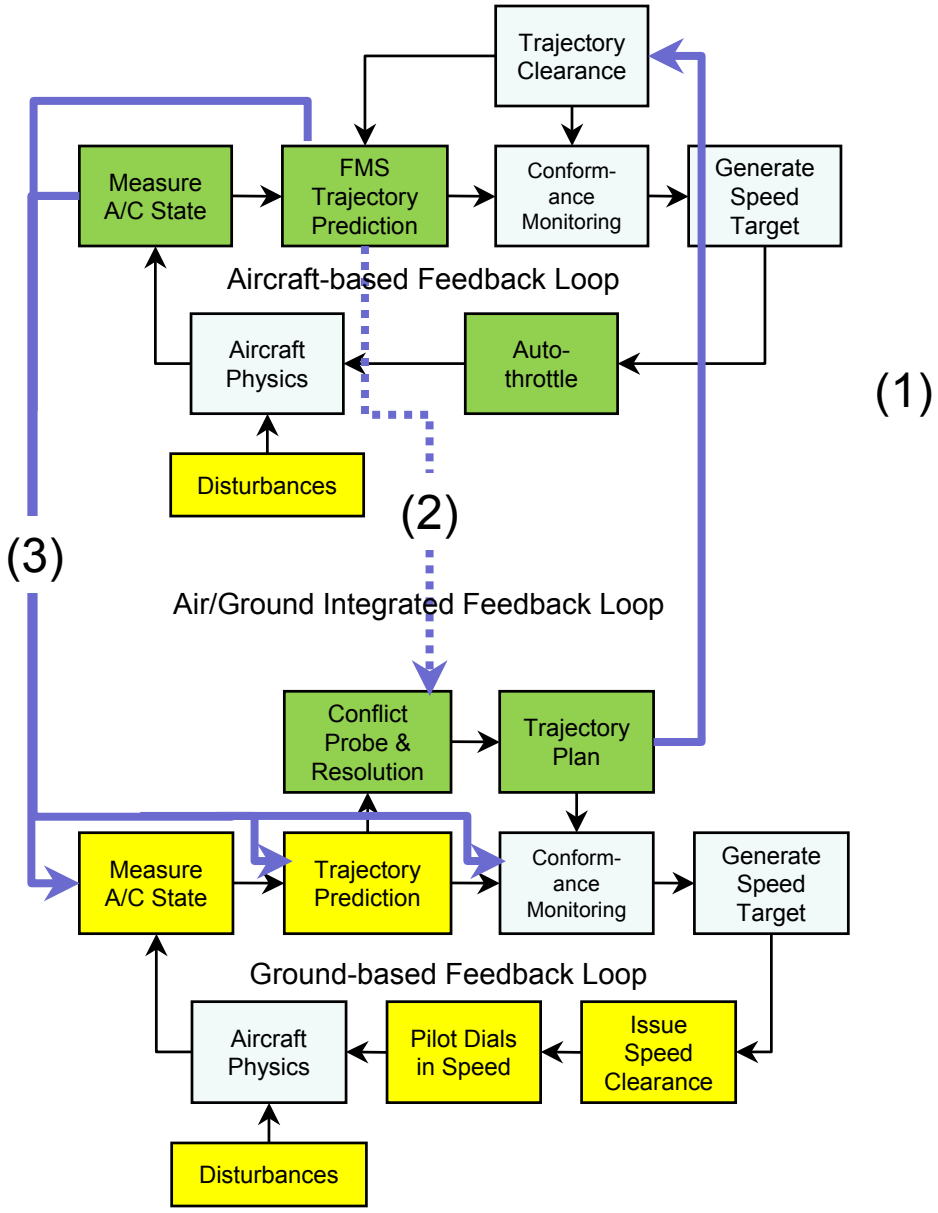
Delegate tracking of 4D trajectory to aircraft

Key features include:

(1) Trajectory Clearance Uplink
- 2D lateral route with altitude and time / speed constraints

(2) Clearance Request Downlink
- Flight crew proposed modified route

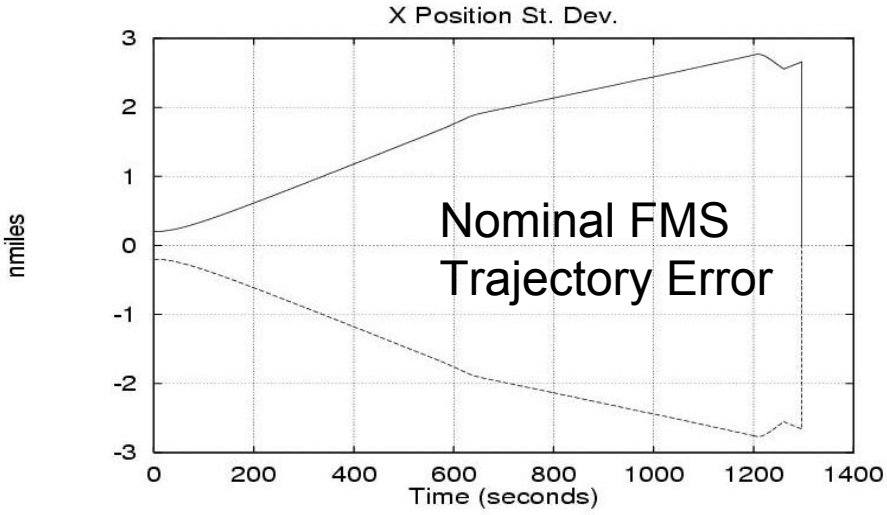
(3) Trajectory Monitoring
- Trajectory downlink, e.g. ADS-C EPP
- Proposed downlink of earliest / latest ETAs at specified waypoints

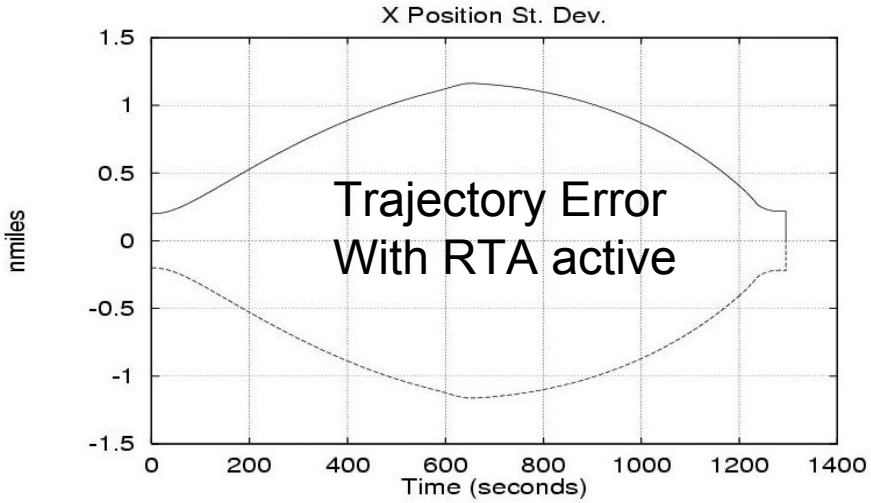


Linear Analysis Results

Ref: "Sensitivity of Trajectory Prediction in Air Traffic Management and Flight Management Systems", Michael R. C. Jackson, Ph.D. Thesis, University of Minnesota, Dec 1997.

- RTA Reduces Trajectory Error
  - Nominal FMS trajectory sensitivity shown with a given set of disturbances
    - Very similar results to Tailored Arrivals
    - My error sources appear to be about 50% worse (2.6 mile vs. 1.5 mile St Dev)
  - RTA control reduces trajectory sensitivity most dramatically at end, but also through whole trajectory.





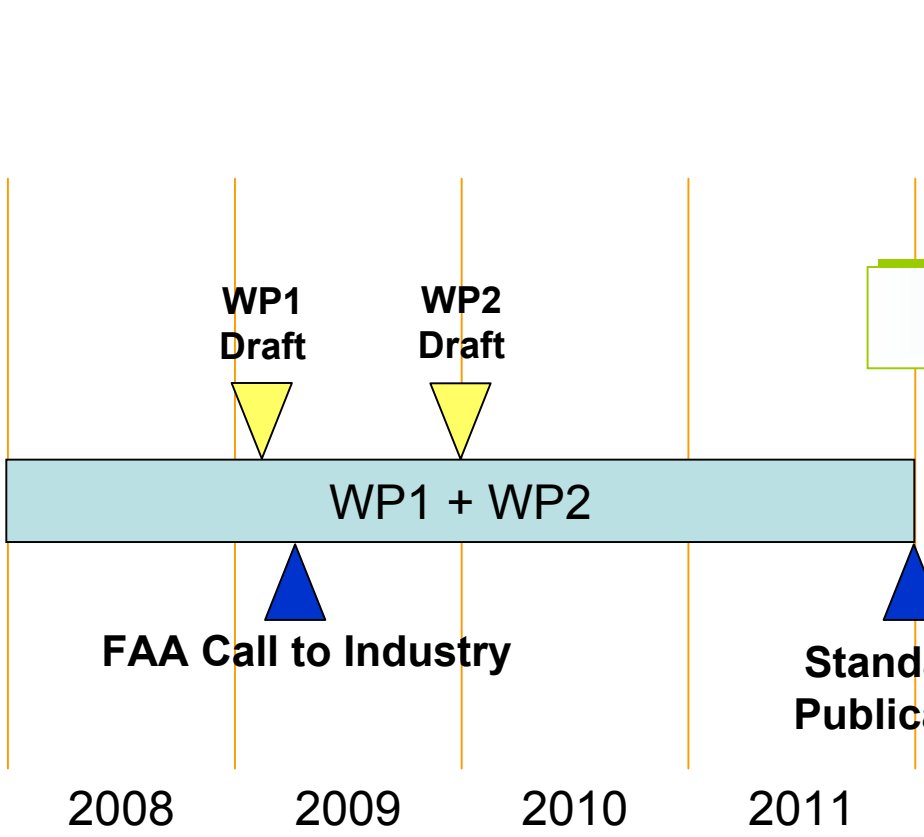
Time-based vs. Relative Spacing

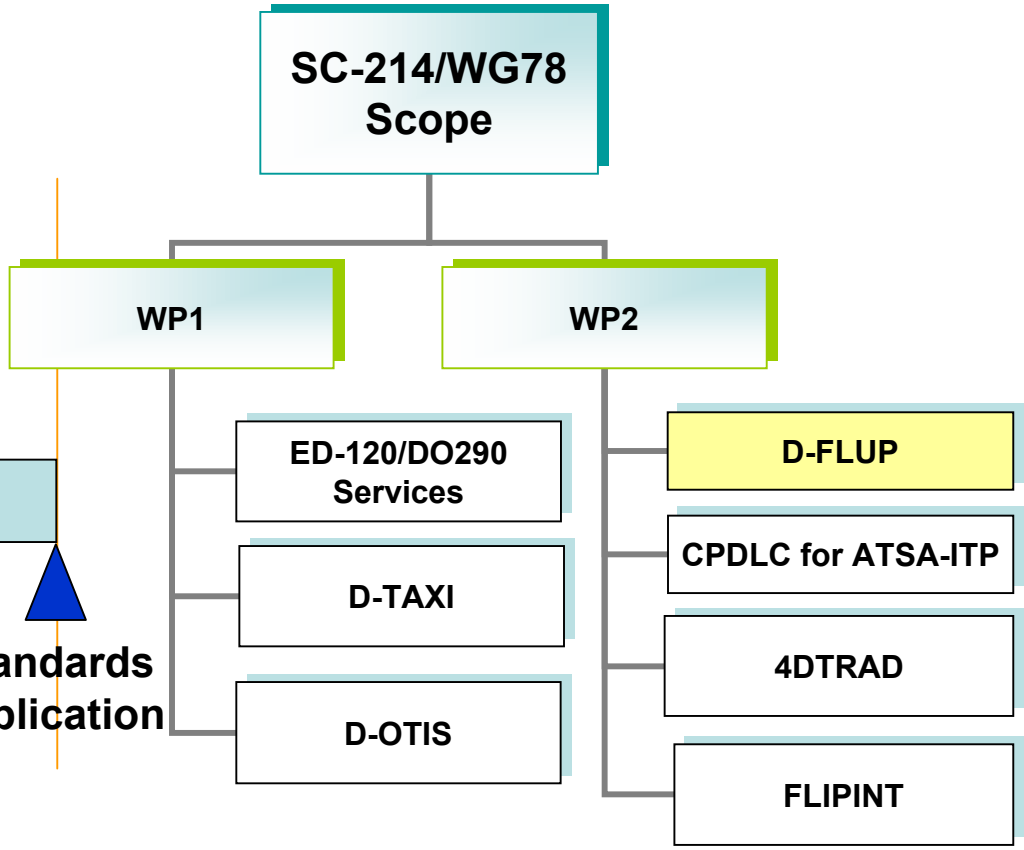
- Complementary tools
  - Not an “either / or”
- Time-based for long term strategy
  - Setting up the flow
  - Usable in low density
- Relative spacing handles problems as density gets higher
  - Corrects for

SC-214 / WG-78 TORs

- **Standards for Air Traffic Data Communication Services**
  - **Produce data link standards for NextGen and SESAR**
  - **DO-264/ED-78A Process**
  - **Backwards compatibility**
    A. **FANS 1/A – ATN INTEROP Standard (DO-305/ED-154)**
    B. **ATN B1 INTEROP Standard (DO-280B/ED-110B)**
    C. **Continental SPR Standard (DO-290−Chg 2/ED−120−Chg 2).**
    D. **FANS 1/A INTEROP Standard (DO-258A/ED-100A)**
    E. **SPR Standard for Air Traffic Data Link Services in Oceanic and Remote Airspace (DO-306/ED-122).**
  - **Coordinate**
    - **FAA, ICAO, EUROCONTROL,ATMAC R & P, PARC CWG, AEEC**

SC-214/WG-78 Work Organisation





SC-214/WG78 Work Plan

P5	P6	P7	P8	P9
22sep08	8dec08	9mar09	21sep09	7dec09
Washington	**Toulouse**	**Seattle?**	**Toulouse?**	**Washington**
	WP1+ 4DTRAD OSD Draft	WP1 Draft 4DTRAD OSD comments rev.	WP1 +WP2 Draft	WP1 +WP2 comments rev.

P10	P11	P12	P13	P14
Sep10		May11	Sep11	Dec11
Brussels				
MET Interop		Changes Consolidation	Standards For FRAC	Standards Ready

4D Trajectory Datalink – “4DTRAD”

- 4DTRAD defines the following services
  - Ground uplink of 4D trajectory clearance
    - Uplink can include 0, 1, or multiple RTA constraints
  - Aircraft downlink of 4D trajectory request
    - User-preferred trajectory
  - Coordination required between multiple ATC units.
  - Trajectory Conformance Monitoring (ADS-C)

- Service description acknowledges importance of similar wind/temperature models between air and ground trajectory prediction systems, but definition of wind/temperature datalink messages currently beyond scope of SC214.

2007: “It looks like the service to get a wind/temperature uplink specific to the flight plan route is falling through the cracks.”

2008 update: it’s getting discussed, but only as a long term capability. The SC214 group still isn’t taking ownership of it.

For More Information

http://www.faa.gov/

search for “sc-214”

http://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/techops/atc_comms_services/sc214/

PARC TBO Action Team

- **Statement of Objective**

  There are many groups which are using the NextGen and OEP terms “Trajectory” (4D, 3D & 2D) and “Trajectory Based Operations” (TBO) in various aspects of their plans and work. The groups are each looking at these related concepts from a particular viewpoint (air / ground data transfer, dependent surveillance, aircraft control, etc.) leading to different understandings and definitions. The objective for this action team is to assess the current state of industry / government activity relative to these concepts, providing an analysis of gaps & overlaps in definitions and other information in currently on-going work, and to recommend ways to resolve identified gaps and overlaps.

- **Statement of scope of task/activity:**

  The scope of activity will be limited to the following four goals:

  – Assessing the current (multi-group) concepts & approaches to TBO
  – Performing a comparative analysis of TBO concept & approaches
  – Performing a gap analysis of the concepts vs current capabilities
  – Assessing impact of gaps or overlaps on needs to enable TBO

- **What is the expected deliverable/product:**

  The following deliverables will align with the particular scope items above:

  1. A list of TBO characteristics / definitions to be assessed across the groups involved in any aspect
  2. A list of the relevant working groups and a technical contact within each who can work with this action team to communicate that group’s concepts
  3. Comparative analysis of key concepts, definitions and applications of TBO
  4. Recommendations for closing gaps and /or reducing overlaps in the surveyed activities

- **Mike Cramer, MITRE, is Action Team Leader**

List of groups under survey

SC-186	ADS-B
SC-159	ECEF approach coordinate under LAAS
SC-214	Datalink, the group has a subcommittee developing 4DTrajectory model for use in operations
SC-189 & PARC CWG	Communications performance
AEEC FMS Committee	FMS Standards
JPDO ACWG	
JPDO AESC	Aircraft equipage
JPDO ANSWG	Air navigation services based on TBO
JPDO ENV WG, Ops SC	Effect of TBO on environmental concerns; emissions, noise
ATMAC R&P	
JPDO IWP Owners	
NASA	Historical and new 4D work
REDAC	
JPDO	
SESAR	
ICAO SASP	
ICAO ATMRPP FFPL	Trajectory definition, future flight plan definition
FAA / EURO AP 4	"action plan"
FAA / EURO AP 16	
FAA / EURO AP 23	

Backup Slides

Standards Development Waterfall

Environment Review & Revision

Operational Service Definition

Operational Safety Analysis

Operational Performance Analysis

Safety & Performance Requirement Definition

Technology Independent Enterprise Information Service Definition

Operational Services and Environment Document (OSED)

Interoperability Requirement Definition
- **ATN**
- **ARINC 623**
- **FANS Accommodation**
- **Internet Protocol**

Subsequent Activities

Avionics Implementations

2-3 years

Installation in Airline Fleet

7 years

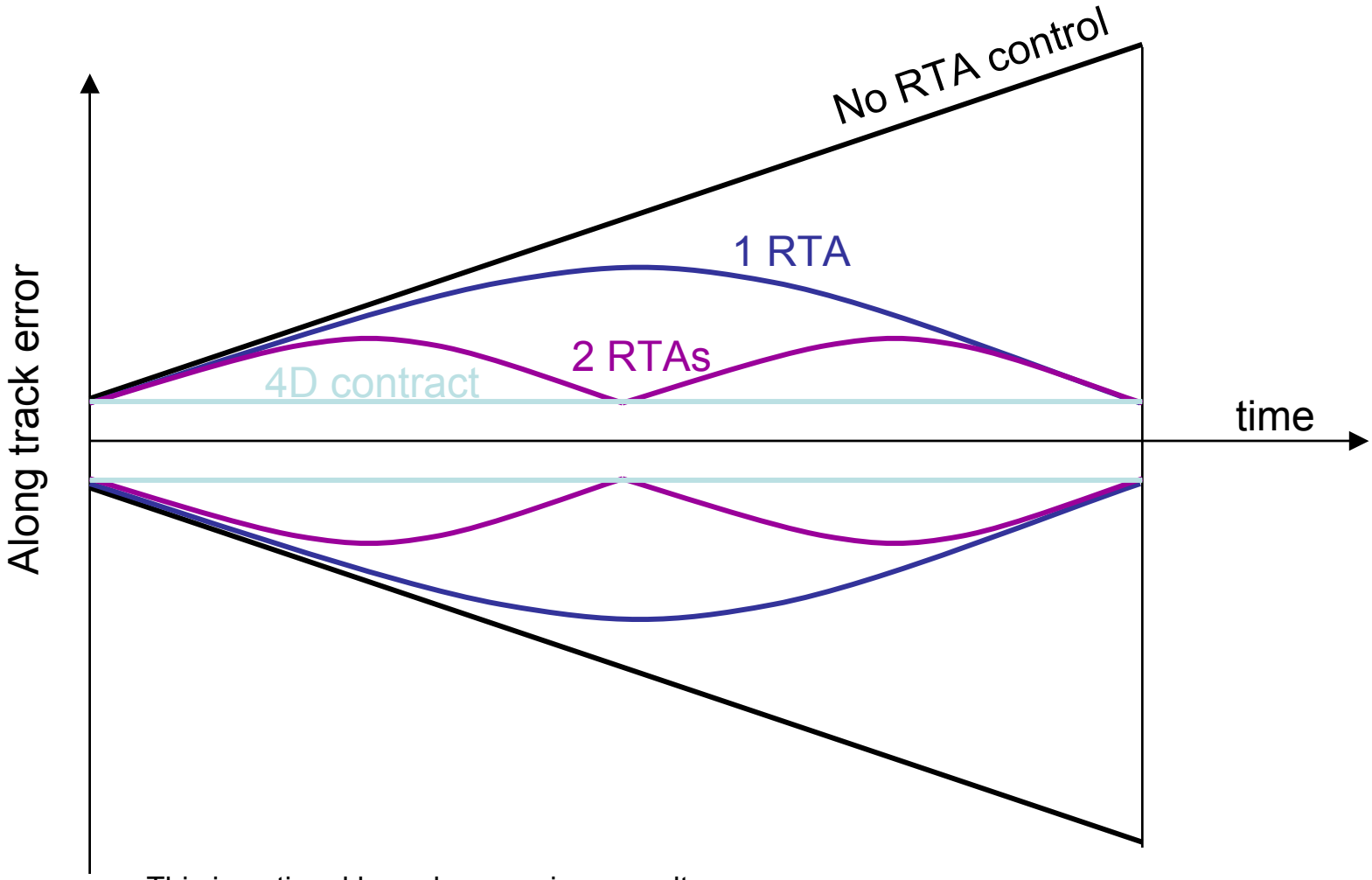
Ground Automation Tool Developments

X years

Installation in ATC Facilities

Y years

Multiple RTA Effect on Uncertainty



This is notional based on previous results

Multiple Waypoint RTA Example